

No part of the candidate's evidence in this exemplar material may be presented in an external assessment for the purpose of gaining an NZQA qualification or award.

2

91156



911560



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

SUPERVISOR'S USE ONLY

Tick this box if you
have NOT written
in this booklet

Level 2 Biology 2022

91156 Demonstrate understanding of life processes at the cellular level

Credits: Four

| Achievement | Achievement with Merit | Achievement with Excellence |
|--|---|--|
| Demonstrate understanding of life processes at the cellular level. | Demonstrate in-depth understanding of life processes at the cellular level. | Demonstrate comprehensive understanding of life processes at the cellular level. |

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL

16

QUESTION ONE: PHOTOSYNTHESIS

All plants require specific reactants to start the process of photosynthesis.



Source: <https://www.doc.govt.nz/nature/native-plants/>

- (a) Describe the reactants required for photosynthesis AND how they enter the plant.

Photosynthesis needs carbon dioxide, water and sunlight.

Carbon dioxide + water $\xrightarrow{\text{sunlight}}$ Oxygen + Glucose

Water enters through the roots. Carbon dioxide and light enters through the leaves.

3

- (b) Photosynthesis takes place inside the chloroplasts. The main structures involved in photosynthesis are: the outer membrane, inner membrane, stroma, thylakoid membrane, and grana.



Adapted from: www.mcqbiology.com/2013/04/multiple-choice-questions-on-chloroplast.html

Discuss how specific reactants in the light-dependent and light-independent reactions affect the amounts of the products of photosynthesis:

In your answer:

- describe the function of TWO named structures from the chloroplast diagram
- explain how the structures of the chloroplast are built to help them carry out their function
- discuss how the structures of the chloroplast work together to carry out the process of photosynthesis.

~~Chloro~~ chlorophyll is in the thylakoid membrane. The thylakoid membrane is where the light dependent reactions take place. It is located close to the membrane of the cell. This allows the sunlight to easily diffuse into the thylakoid membrane. There are lots of the thylakoid membrane which allows for more light dependent reactions to take place. The stroma is where the light independent reactions take place. It is ~~the~~ throughout the ~~whole~~ cell and surrounds the granum where the thylakoid membrane is. So the ~~etc~~ products from the light dependent reaction can be easily transported to the light independent. This process provides the

There is more space for your answer to this question on the following pages.



energy needed by the enzymes ~~to~~ for photosynthesis to take place. The structure of the chloroplast works to help the process of photosynthesis as it is close to the top of a plant leaf. ~~§~~ The outer membrane is transparent so allows ^{more} sunlight to diffuse into the chloroplast, making more photosynthesis able to take place. The thylakoids are arranged in stacks called Granum, this increases the surface area so provides more places for the photosynthesis reactions to take place. The Stroma being around all the granum also helps photosynthesis to take place. It provides a good medium for the reactants to go through to get to the chlorophyll.

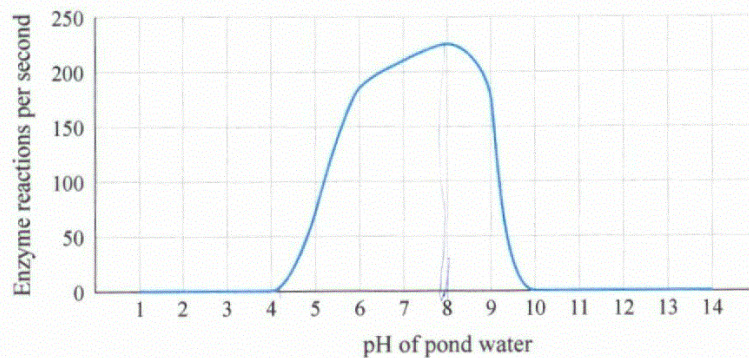
Lined area for writing.

QUESTION TWO: ENZYMES

Conditions of the water in a small pond can change throughout the day, and over a year. A change in pH can affect the rate of photosynthesis reactions. The presence of pollutants in the water can affect certain nutrients that are needed as co-factors for the enzymes involved in photosynthesis.

In an experiment to test the effect of pH on enzyme activity in *Elodea* cells, the following results were produced.

Rate of *Elodea* enzyme reactions as a result of changing pH



Adapted from: <https://pubmed.ncbi.nlm.nih.gov/20118304/>

- (a) Discuss the effects of pH and co-factors on enzyme activity in *Elodea* plants.

In your answer you should refer to the graph above and:

- describe the function of enzymes and their structure
- explain how co-factors affect enzyme activity
- discuss how and why pH affects enzyme activity in *Elodea*.

An enzyme works as a catalyst. They have an active site where the substrate fits in, it is specific to the reaction they catalyse so only 1 kind will fit. The active site is held together by hydrogen bonds. If these hydrogen bonds break the enzyme will denature and will no longer be able to catalyse its specific reactions. Co-factors affect enzyme activity, these are things that will affect how well the enzyme works, pH, temperature, concentration. For example if the temperature is too hot the hydrogen bonds will break, too cold and the enzyme will work too slowly. When these co-factors are at optimum the enzyme can work at its best. They slot into the active site with the substrate. Some substrates do

not perfectly fit into their enzymes active site. so they need co-factors, without these the enzyme is unable to catalyse the reaction. pH also affects enzyme activity. When the pH is at its optimum the enzyme can catalyse as many reactions as it can. If the pH is too low it will work very slowly or not at all, as shown in the graph. From pH of 0-4 no enzyme reactions occurred. when it got to a pH of 8 it reached its optimum. This is where the enzyme in Elodea plants can catalyse as many reactions per second as it can. After 8 the reactions per second start to slow down. And when it reaches a pH of 10 stops catalysing reactions all together. This is because when the pH gets too high the hydrogen bonds that hold the active site together ^{break} ~~denature~~ so the enzyme denatures and is unable to catalyse any more reactions.

There is more space for your answer to this question on the following pages.

Lined area for writing.

**This page has been deliberately left blank.
The examination continues on the following page.**

QUESTION THREE: CELLULAR RESPIRATION

Mosquito larvae come to the surface of the water and absorb oxygen through a breathing tube. When threatened, the larvae retreat to the bottom of the pond where they can absorb dissolved oxygen from the water.

Mosquito larvae are transparent, and it is possible to observe their hearts beating under a microscope. The number of heart beats per minute can be used as a way to measure the cell respiration rate of the heart cells, and to study the factors that affect it.



Source: https://en.wikipedia.org/wiki/File:Culex_sp_larvae.png

- (a) Describe the purpose of cellular respiration.

To produce ATP (energy) which is used to fuel enzyme reactions and other body functions.

- (b) As oxygen levels in the water decrease, respiration rate, and therefore heart rate decreases. Even when the water has NO oxygen left, the mosquito larvae's hearts could continue to beat.

| Dissolved oxygen concentration (% saturation) | Heart beats per minute with changing dissolved oxygen concentrations in pond water | | | | |
|---|--|----|----|----|-----|
| | 0 | 25 | 50 | 75 | 100 |
| Number of heart beats per minute (bpm) | 20 | 40 | 50 | 60 | 120 |

Discuss the observations above in relation to aerobic and anaerobic respiration, and their effect on the mosquito larvae's heart rates.

In your answer, refer to the data table and include:

- a description of where aerobic and anaerobic respiration take place in the cell
- an explanation of BOTH respiration processes that includes the materials required for each and their products
- elaborate on the possible effects on larval heart rate and type of respiration when exposed to 0% oxygen for more than a few hours.

Cytoplasm
mitochondria

Anerobic respiration takes place in the Cytoplasm.

Glucose \rightarrow ATP + lactic acid / ethanol

It does not require oxygen, only Glucose. It produces ATP and lactic acid. When there is 0% oxygen in the water this is the respiration process that the mosquito larvae uses. It does not require oxygen and gives off less ATP than Aerobic, so their hearts would be beating ~~faster~~ ^{slower}. This is the system they use when they have 0% Oxygen. The heartbeats will be slower, but if they are exposed to 0% oxygen for a few hours it is likely that their hearts will stop beating. This is because anerobic is a short term respiration system and the lactic produced will get too much for the larvae as they are unable to clear it without oxygen. Aerobic respiration takes place in the Cytoplasm and then the Mitochondria.

Oxygen + ~~Glucose~~ ^{Glucose} \rightarrow 38 ATP + Carbon dioxide + water

It requires Oxygen and glucose and produces 38 ATP, Carbon dioxide and water.

There is more space for your answer to this question on the following pages.

Lined area for writing.

Extra space if required.
Write the question number(s) if applicable.

QUESTION
NUMBER

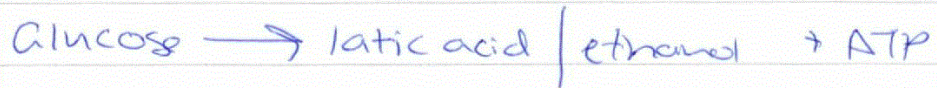
Extra space if required.
Write the question number(s) if applicable.

QUESTION
NUMBER

Aerobic



Anerobic



91156

| | | | | | |
|-----------------|--------------------|--|-----------|--------------------|-----|
| Standard | 91156 | Display ID | 61634265 | Total score | -16 |
| | | NSN | 139198687 | | |
| Q | Grade score | Annotation | | | |
| 1 | M5 | <p>This is an example of explanations covering the structures of the chloroplast and how these were able to enhance the rate of photosynthesis. To get to a higher grade, full discussion would be needed between the reactants and products of each phase, linked to the structures involved.</p> <p>Pg 3</p> <p>The stroma is where the light independent reactions take place and surrounds the grana/thylakoid membrane so products from the light dependent reaction can be easily transported to the light independent reaction.</p> <p>More detail needed to explain how chlorophyll allows the light dependent reaction to proceed.</p> <p>Pg 4</p> <p>The outer membrane is transparent allowing more sunlight into the chloroplast making more photosynthesis take place.</p> <p>The thylakoids are arranged in stacks called grana, this increases the surface area so provides more places for the photosynthesis reactions to take place.</p> | | | |
| 2 | M6 | <p>This is an example of explanations covering the role of co-factors and effects of pH on enzyme activity. To get to a higher grade, a full discussion of the effects of both high and low pH and the optimal range of the enzyme would be needed linked to the resource information supplied.</p> <p>Pg 6</p> <p>Co-factors affect enzyme activity, they slot into the active site with the substrate, without these the enzyme is unable to catalyse the reaction.</p> <p>Pg 7</p> <p>When the pH gets too high, the hydrogen bonds that hold the active site together break so the enzyme denatures.</p> <p>When it reaches pH 10, the enzyme stops catalysing because...the enzyme denatures and it is unable to catalyse any more reactions.</p> | | | |
| 3 | M5 | <p>This is an example of explanations of the effects of anaerobic respiration and the results shown in the data table. To get to a higher grade, a full discussion on the effects of</p> | | | |

| | |
|--|--|
| | <p>anaerobic/aerobic respiration would be needed, linked to the context and numbers provided.</p> <p>Pg 11</p> <p>If they are exposed to 0% oxygen for a few hours, it is likely that their heart will stop beating, because lactic acid produced will get too much for the larvae.</p> <p>Anaerobic is the system they use when they have 0% oxygen. It does not require oxygen and gives off less ATP than aerobic so the heart would be beating slower.</p> |
|--|--|